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December 9, 2025

Hiring Committee
Amazon
Applied Scientist / Research Scientist Roles

Dear Hiring Committee,

I am writing to express my interest in Research Scientist and Applied Scientist roles within Amazon's Middle Mile Science, Last Mile Science, SCOT, ATS, and AGI organizations. My background includes a B.Tech in Computer Science from IIT Madras, an MS in Computer Science from Purdue University, and prior industry experience as an SDE at Amazon (SCOT).

My current research focuses on building **Routing Foundation Models (RFM)**—neural architectures for large-scale logistics optimization that integrate neural surrogate MILP solvers, diffusion-based routing priors, constraint-aware graph transformers, sequential world models, and real-time refinement networks.

Why Amazon. Amazon's middle-mile and last-mile logistics systems present some of the world's most ambitious ML+OR challenges: time-windowed MILPs, global transportation networks, large-scale simulation, SLA forecasting, congestion propagation, and real-time re-optimization. My research directly targets these domains. Amazon is uniquely positioned in terms of scale, data richness, and operational complexity to support—and benefit from—neural optimization systems and differentiable planning models.

Summary of Research Contributions. My current work centers on a single, unified research program: **Routing Foundation Model (RFM)**, a full-stack neural optimization architecture for large-scale routing and mixed-integer linear programs (MILPs). RFM is designed for Amazon-scale networks and integrates five core components:

- **MILP-Aware Encoder** — embeds variables, constraints, facility types, and graph topology directly from (A, b, c) , constructing a bipartite constraint–variable interaction graph for neural processing.
- **MILP-Transformer (Surrogate Solver)** — a transformer architecture augmented with dual violation signals $v = \max(0, Ax - b)$ and dual ascent messages $A^\top v$. Each layer acts as an optimization-like refinement step, approximating primal–dual solver dynamics with constraint-specific Mixture-of-Experts and proximal updates.
- **Neural Routing Optimization Model (NROM)** — a global reasoning module that combines graph attention and MILP structure to generate high-quality initial routing assignments before refinement.

- **Diffusion Routing Prior** — a diffusion model that learns the distribution of feasible routing structures and produces warm-starts that reduce MILP cold-start latency and improve solution stability.
- **Routing World Model (SSM/Mamba)** — a sequential dynamics model forecasting congestion, timing delays, facility saturation, and SLA-risk evolution, enabling multi-step planning and scenario rollouts.

These modules form a differentiable, constraint-aware surrogate solver that amortizes optimization across logistics networks, delivering fast, near-feasible routing decisions at scale.

The full technical monograph is available at: ritwikareddykanchala.github.io/rfm.pdf

Team Fit. The methods I build align strongly with the scientific scope of the following teams:

- **Middle Mile Science / Transportation Science** — routing MILPs, linehaul planning, capacity modeling.
- **Last Mile Science** — dynamic dispatch, SLA prediction, congestion forecasting.
- **SCOT Optimization Science** — surrogate optimization, scenario planning, network simulation.
- **ATS Science** — air hub interactions, cross-dock routing, facility constraints.
- **Amazon AGI** — world models, neural planning, differentiable simulators.

I would welcome the opportunity to contribute to Amazon's scientific vision and to collaborate with teams advancing large-scale optimization, routing intelligence, and ML-driven logistics reliability. Thank you for your time and consideration.

Sincerely,
Ritwika Kanchala